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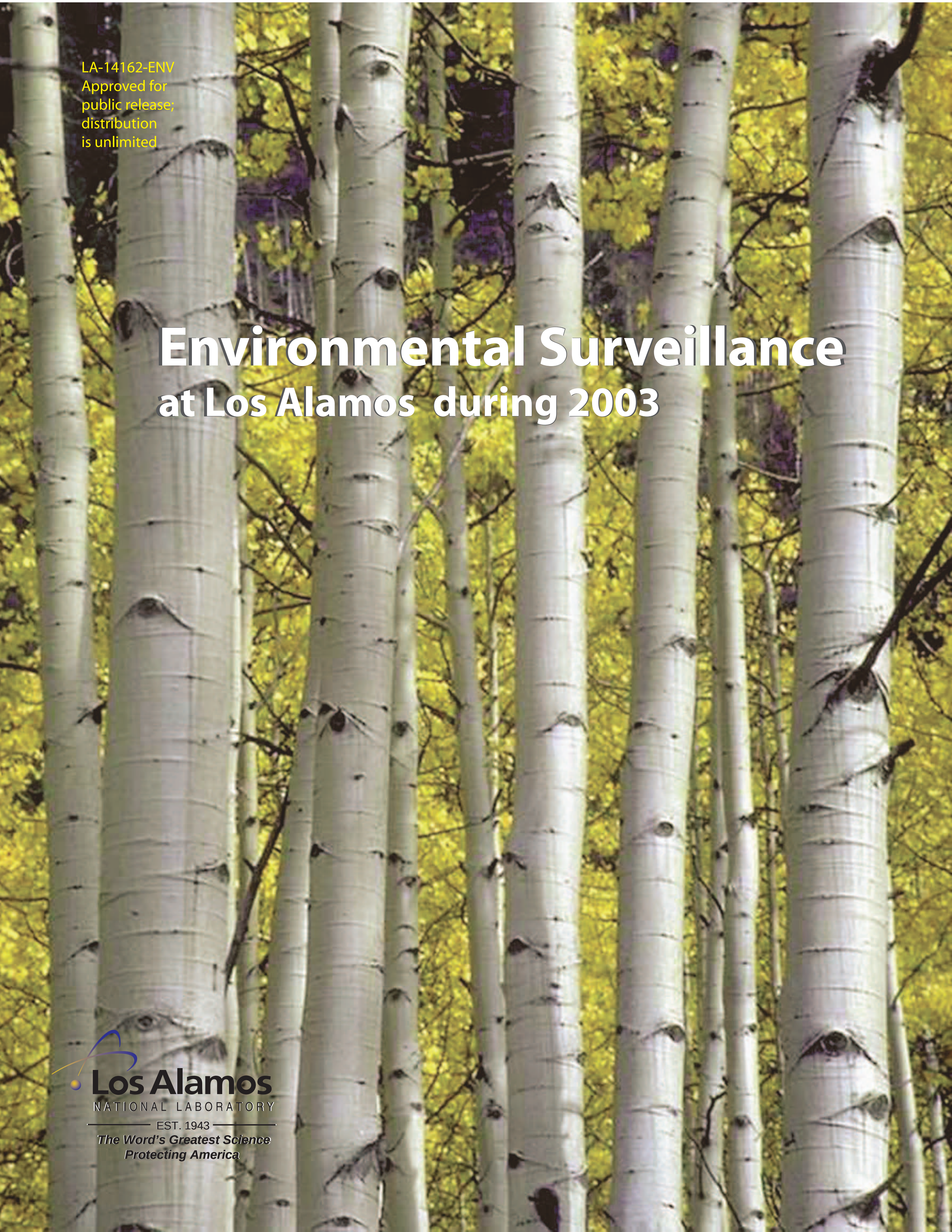

Environmental Surveillance
at Los Alamos during 2003

Los Alamos
NATIONAL LABORATORY
EST. 1943
The World's Greatest Science Protecting America

Enhancing Our Stewardship of the Environment

The Laboratory places a priority on simultaneously fulfilling our mission responsibilities and our environmental stewardship responsibilities. The overall goal of our stewardship efforts is to minimize negative impacts and ensure a healthy environment. We monitor our performance to demonstrate the fulfillment of these responsibilities. This annual environmental report describes the 2003 successes of our environmental stewardship. The monitoring information focuses on operations. The monitoring program addresses changes from baseline conditions before the Cerro Grande fire of 2000 and will aid in evaluating any future impacts the Laboratory may have, especially those resulting from contaminant transport off-site.

The program involves a number of different organizations within the Laboratory, as well as coordination with outside organizations and agencies. The primary Laboratory organizations involved are the Meteorology and Air Quality Group (RRES-MAQ), the Water Quality and Hydrology Group (RRES-WQH), the Solid Waste Regulatory Compliance Group (RRES-SWRC), the Ecology Group (RRES-ECO), and the Environmental Restoration Project (RRES-RS).

The Risk Reduction and Environmental Stewardship (RRES) is incorporated to strengthen the Laboratory's commitment to managing the entire life-cycle of nuclear materials from generation to permanent disposal as well as to understanding and safeguarding the natural environment on a local to global scale. Over the next two decades, billions of dollars will be invested globally in managing nuclear materials and waste, cleaning up the environment, and protecting and restoring the natural environment. To this end, RRES has highlighted the following strategic environmental science program thrust areas:

- Natural Resources Protection and Restoration,
- Nuclear Waste and Materials Management, and
- Repository Science.

The role of this division is to reduce the risk of current and historic Laboratory activities to the public, workers, and the environment through natural and cultural resource protection, pollution prevention, waste disposition, and remediation activities. The division serves as the steward of the Laboratory reservation by developing and implementing integrated natural and cultural resource management.

This report summarizes the results of the ongoing routine environmental monitoring and surveillance program, for which the Laboratory collects more than 12,000 environmental samples each year from more than 450 sampling stations in and around the Laboratory. In addition, we have summarized results from sampling for effects of the Cerro Grande fire, especially where the fire has resulted in alterations of trends in environmental conditions seen in past years. We will continue to follow the alterations resulting from the wildfire over the next few years to determine if conditions return to prefire levels.

In the aftermath of the events of September 11, 2001, enhanced security actions by the Department of Energy resulted in the removal of many environmental World Wide Web pages from public access. At this writing, it is unknown how many pages these actions have affected and when the pages will be accessible again to the general public. If you have difficulty reaching the sites referenced in this document, please contact me, Jean Dewart, at dewart@lanl.gov or 505/665-0239. We will make every attempt to get you the information that you desire.

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Issued: September 2004

Environmental Surveillance at Los Alamos during 2003

Environmental Surveillance Program:

Meteorology and Air Quality (Group RRES-MAQ)
505-665-8855

Water Quality and Hydrology (Group RRES-WQH)
505-665-0453

Solid Waste Regulatory Compliance (Group RRES-SWRC)
505-665-9527

Ecology (Group RRES-ECO)
505-665-8961

Los Alamos National Laboratory
EST. 1943

Los Alamos NM 87545

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Environmental Surveillance at Los Alamos reports are prepared annually by the Los Alamos National Laboratory (the Laboratory), Risk Reduction and Environmental Stewardship, as required by US Department of Energy Order 5400.1, *General Environmental Protection Program*, and US Department of Energy Order 231.1, *Environment, Safety, and Health Reporting*.

These annual reports summarize environmental data that are used to determine compliance with applicable federal, state, and local environmental laws and regulations, executive orders, and departmental policies. Additional data, beyond the minimum required, are also gathered and reported as part of the Laboratory's efforts to ensure public safety and to monitor environmental quality at and near the Laboratory.

Chapter 1 provides an overview of the Laboratory's major environmental programs. Chapter 2 reports the Laboratory's compliance status for 2003. Chapter 3 provides a summary of the maximum radiological dose a member of the public could have potentially received from Laboratory operations. The environmental data are organized by environmental media (Chapter 4, air; Chapters 5 and 6, water; Chapter 7, soils; and Chapter 8, foodstuffs and biota) in a format to meet the needs of a general and scientific audience. A glossary and a list of acronyms and abbreviations are in the back of the report. Appendix A explains the standards for environmental contaminants, Appendix B explains the units of measurements used in this report, and Appendix C describes the Laboratory's technical areas and their associated programs.

We've also enclosed a disk with detailed tables of data from 2003.

Inquiries or comments regarding these annual reports may be directed to

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This report is also available on the World Wide Web at
http://www.airquality.lanl.gov/pdf/ESR/LA-14162-ENV.pdf
and the supplemental data tables are available at
http://www.airquality.lanl.gov/ESRIndex2003.htm

EXECUTIVE SUMMARY
Environmental Surveillance—2003

LA-14162.ENV

Table ES-1. Environmental Statutes under which LANL Operates

Federal Statute	*What it Covers*	*Status*
Resource Conservation and Recovery Act (RCRA)	Generation, management, and disposal of hazardous waste and cleanup of inactive, historical waste sites.	The Laboratory is operating under an extension of the previous permit while seeking to renew its RCRA permit. Negotiations are continuing on the order NMED issued in 2002 that required extensive site investigation and monitoring. NMED issued two other compliance orders in early 2004.
Emergency Planning and Community Right-to-Know Act (EPCRA)	The public's right to know about chemicals released into the community	As required, for 2003 the Laboratory reported releases and waste disposal totaling 56,756 lb of lead, 6,960 lb of mercury and 331 lb of nitric acid.
Clean Air Act (CAA)	Air quality and emissions into the air from facility operations	The Laboratory met all permit limits for emissions to the air. The dose to the Maxim Exposed Individual (MEI) from LANL air emissions was 0.65 mrem, much less than the annual limit of 10 mrem. The principal contributor to the dose was the Los Alamos Neutron Science Center (LANSCE).
Clean Water Act (CWA)	Air quality and emissions into the air from facility operations	Discharges met requirements in 100% of samples from sanitary effluent outfalls, 99.5% of samples from industrial effluent outfalls, and 100% of water quality parameter samples at both types of outfalls. The groundwater protection program completed six new wells; initial sampling showed trace levels of tritium, perchlorate, or nitrate in some of the wells.
Safe Drinking Water Act (SDWA)	Drinking water supplies	Los Alamos County provides the Laboratory's drinking water supply. During 2003, drinking water met all limits for chemicals, radiological materials, and bacteria.
Toxic Substances Control Act (TSCA)	Chemicals such as PCBs	The Laboratory continues to operate under an administrative extension of its TSCA letter of authorization. The Laboratory disposed of 4,400 kg of capacitors and 6,949 kg of fluorescent light ballasts in 131 shipments to an off-site, EPA-permitted treatment and disposal facility.
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	Storage and use of pesticides	The Laboratory's storage and use of pesticides remained in compliance with regulatory requirements.
Endangered Species Act (ESA)	Rare species of plants and animals	The Laboratory's biology team reviewed new projects and ensured compliance with the Endangered Species Act.
National Historic Preservation Act (NHPA) and others	Cultural resources	The cultural resources team worked on 26 projects in the field and identified 19 new archeological sites and 25 new historic buildings; 49 historic buildings were determined eligible for the National Register.
National Environmental Policy Act (NEPA)	Consideration of potential environmental impacts in deciding on new operations	The NEPA team completed 2 environmental assessments for which FONSI determinations were made and prepared a third; also the team prepared a supplementary analysis to determine if further environmental assessment was necessary for one project.

EXECUTIVE SUMMARY

Los Alamos National Laboratory (LANL or the Laboratory) is managed by the University of California under a contract administered by the National Nuclear Security Administration (NNSA) of the Department of Energy (DOE). This report (1) presents environmental data and analyses that characterize performance in 2003 and (2) addresses compliance with environmental regulations. Using comparisons with standards and regulations, this report concludes that the environmental effects from Laboratory operations are small and do not pose a threat to human health or the environment.

Environmental Compliance at Los Alamos in 2003 (See Chapter 2.)

Many activities at LANL use or produce materials that are radioactive or otherwise hazardous. Laboratory policy implements DOE requirements by directing employees to protect the environment and meet compliance requirements of applicable state and federal environmental-protection regulations. Federal and state regulations provide specific requirements and standards to implement these statutes and maintain environmental qualities. The Environmental Protection Agency (EPA) and the New Mexico Environment Department (NMED) are the principal administrative authorities for these laws. The DOE and its contractors are also subject to the Department's requirements for control of radionuclides. Table ES-1 presents a summary of the Laboratory's status in regard to environmental statutes and regulations.

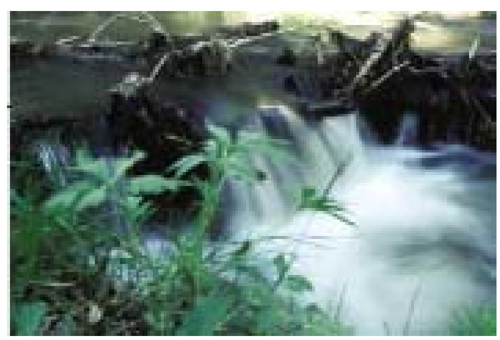


Table ES-2. Where are the Sources of Radiological Doses?

Pathway	*Dose*	*Location*	*Trends*
Air	0.65 mrem/yr	East Gate	None; remains well below regulatory limits
Direct irradiation	2.5 mrem/yr	TA-18, Pajarito Road	None
Food	<0.1 mrem/yr	All sites	None
Drinking water	<0.1 mrem/yr	All sites	None
Background	300 to 500 mrem/yr	All sites	N/A
Dose to wildlife	<0.1 rad/day	All sites	None
Dose to aquatic biota	<1 rad/day	All sites	None

Table ES-3. Where Can We See LANL Impacts on Air?

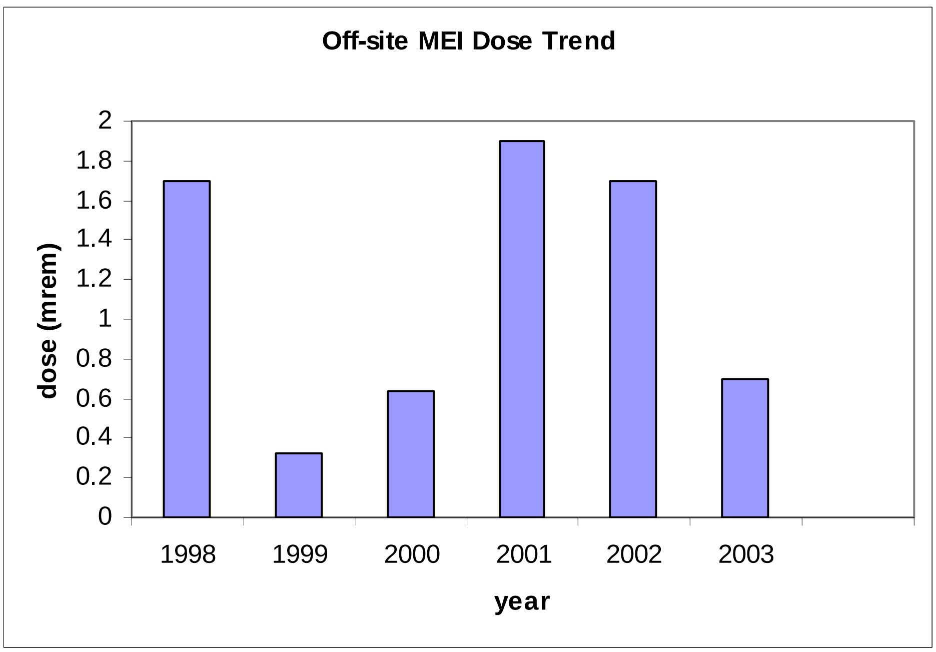
Radionuclide or Air Contaminant	*On-Site*	*Off-Site*	*LANL-Caused Off-Site Significance (% of the EPA Standard)*
Tritium	Yes, found at most sampling locations	Yes, measurable at many perimeter samples	About 1%
Gross alpha and gross beta	No, but in two previous years found at Area G from transuranic releases	No detectable measurements off-site	No standard
Uranium	Yes, multiple locations found with measurable depleted uranium	Yes, increased frequency of depleted uranium found at perimeter locations after the Cerro Grande fire, but less frequently in 2003 than 2002	Less than 1%
Americium and plutonium	Yes, found mostly at TA-21 and Area G	Yes, plutonium-239 found near TA-1 and occasionally at other perimeter samplers	About 1%
Beryllium	No, but in previous years short-term concentrations have been above background	No, off-site concentrations all appeared to be natural beryllium, not Laboratory-caused	No standard
Cobalt-60	Yes, found in one sample on-site during the Omega reactor D&D	No detectable off-site measurements	No impact
PM 2.5 (particles less than 2.5 µm in diameter)	Not measured	No, off-site measurements comparable with background levels (about one-half of the EPA standard)	No impact
PM 10 (particles less than 10 µm in diameter)	Not measured	No, off-site measurements comparable with background levels (about one-third of the EPA standard)	No impact

Environmental Radiological Dose Assessment (See Chapter 3.)

Table ES-2 shows the sources and locations of radiological doses and Figure ES-1 shows trends of doses to the maximally exposed individual (MEI) over the last few years at an off-site location.

We calculated potential radiological doses to members of the public that resulted from LANL emissions. During 2003, the population within 80 km of LANL received a collective dose of 0.88 person-rem. The maximum air-pathway dose to a member of the public was 0.65 mrem and was at East Gate. The maximum all-pathway dose to a member of the public was on Pajarito Road adjacent to TA-18 and was 2.5 mrem. These values are similar to previous ones from recent years. Background radiological doses in this area range from about 300 to 500 mrem/yr. No health effects are expected from doses attributable to Laboratory emissions. Calculated doses to nonhuman biota remained below DOE established limits for aquatic and terrestrial systems.

Figure ES-1



Air Surveillance (See Chapter 4.)

Table ES-3 shows locations where radionuclides and other atmospheric releases from LANL have impacted the air.

The radiological air-sampling network, referred to as AIRNET, measures environmental levels of airborne radionuclides that may be released from Laboratory operations. These radionuclides include plutonium, americium, uranium, and tritium. Ambient concentrations during 2003 were generally comparable to or less than concentrations in 2002. Measurable concentrations of tritium were found at most on-site locations and at off-site locations near the perimeter of the Laboratory. Plutonium and americium were occasionally found on site, primarily near decon-tamination and decommissioning (D&D) operations and at Technical Area (TA) 54, Area G,

Table ES-4. Where Can We See Radiological Stack Emission Impacts?

Radionuclide	*Predicted Off-Site Dose (Location)*	*Emission Trend*
Tritium	0.055 mrem (airport)	Slight decrease site wide
Uranium, plutonium, americium	<0.01 mrem (all)	None
Carbon-11, oxygen-15, nitrogen-13, argon-41 (LANSCE emissions)	0.33 mrem (East Gate)	Decreasing

the Laboratory's low-level radioactive waste disposal site. Low concentrations of americium and plutonium were also detected in several perimeter samples. Depleted uranium was detected on-site and near the perimeter of the Laboratory. No detectable concentrations of any radionuclides attributable to LANL were detected at regional samplers in Santa Fe, Española, or El Rancho.

Three investigations took place in 2003 and revealed the following:

- The number of samples with depleted uranium has increased since the Cerro Grande fire—a catastrophic wildfire that burned almost 50,000 acres within and around LANL—at both on-site and perimeter samplers. However, the number of samples with depleted uranium was lower in 2003 than in the previous two years.
- Measurable increases in tritium in the eastern part of the Los Alamos town site have occurred in 2002 and 2003 because of the increases in tritium emissions from the D&D activities at TA-21.
- Cobalt-60 was detected on-site near the D&D activities for the Omega reactor facility.

Direct reading particulate matter samplers were operated at three off-site locations during 2003. Two samplers were operated at each location to measure two different sizes of particulate matter: PM 10 and PM 2.5 (particles less than 10 and 2.5 micrometers in diameter, respectively). Higher wind speeds cause increases in concentrations for both sizes. However the PM 10 concentrations increase faster than the PM 2.5 concentrations because resuspended soil and dust particles tend to be larger than several micrometers. Conversely, other sources, such as industrial processes and forest fires, that produce particles by combustion or condensation have a much greater impact on the PM 2.5 concentrations. Concentrations of particulate matter in Los Alamos County are generally lower than much of the rest of New Mexico because of more precipitation and fewer surface soil disturbances.

Quarterly concentrations of beryllium were similar to those in 2002. Concentrations were consistent with expected values from resuspension of soils with naturally occurring beryllium. The dustiest locations—the Los Alamos County Landfill, Jemez Pueblo, and TA-54—had the highest measured concentrations.

Meteorology

Los Alamos weather for 2003 continued a 6-year trend of warm temperatures and a dryer-than-normal climate. The average annual temperature in 2003 of 50.5°F exceeded the normal annual average of 47.9°F by 2.6 degrees. The total precipitation in 2003 of 9.9 in. was 52% of normal (18.95 in.). The current drought is one of the two most severe droughts of the 80-year instrumental record for Los Alamos, the other occurring in the early-to-mid 1950s.

Air Emissions

While emissions of tritium from TA-21 sites were slight elevated because of ongoing D&D, total emissions from tritium-handling facilities in 2003 decreased slightly from 2002. Tritium operations are being consolidated as older sites are shut down. Emissions of plutonium and uranium isotopes have remained approximately the same since 2000. Emissions from the Los Alamos Neutron Science Center (LANSCE) were reduced from 2002 levels because of the operation of emissions controls systems.

No air releases occurred during 2003 that required reporting to the National Response Center. Table ES-4 presents the locations of stack-emission sampling.

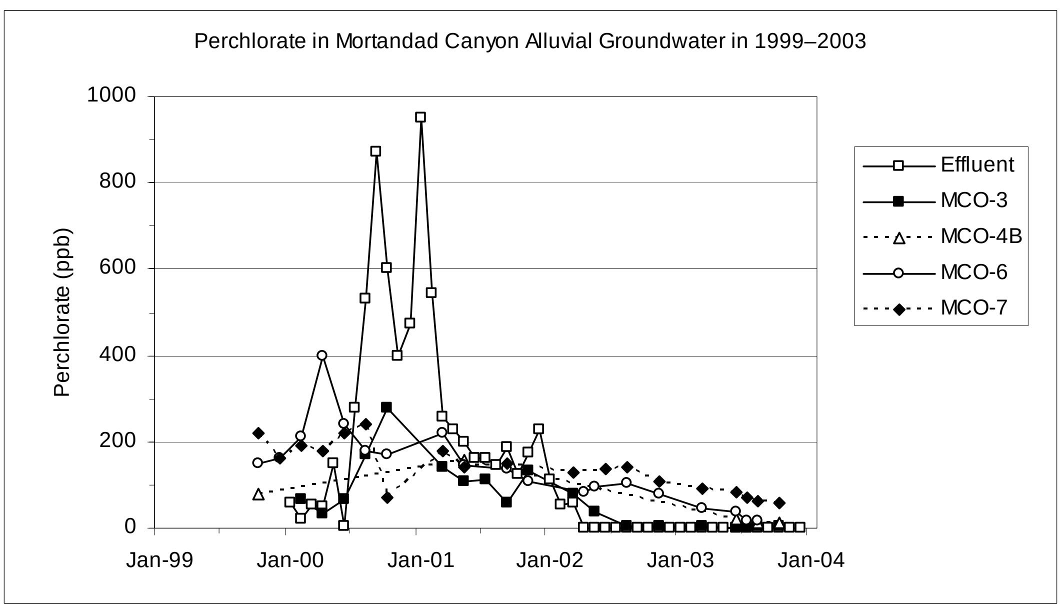
Direct Penetrating Radiation

During 2003, measurements of direct penetrating radiation at most LANL locations were similar to 2002 measured values. The maximum public dose is 2.5 mrem/yr on Pajarito Road adjacent to Pajarito Laboratory (TA-18); this is higher than last year as a result of increased operations at TA-18. At TA-54, Area G, average neutron radiation levels were 50% higher, largely as a result of neutron sources recovered by the off-site source recovery project, *http://osrp.lanl.gov/*. The maximum public dose at the boundary of the San Ildefonso Sacred Area north of Area G is 0.65 mrem/year, which is well below the all-pathway limit of 100 mrem/year.

Table ES-5. Where Can We See LANL Impacts on Groundwater?

Chemical	*On-Site*	*Off-Site*	*Significance*	*Trends*
Tritium	Below MCL in alluvial and intermediate groundwater because of improvement in LANL discharges into Mortandad Canyon	No	Not used as a drinking water supply	Decreasing as effluent quality improves
Other radionuclides	Above DOE or EPA drinking water limits in alluvial groundwater because of LANL discharges in DP, Los Alamos, and Mortandad Canyons	No	Not used as a drinking water supply; radionuclides have not penetrated to deeper groundwater	Some constituents are fixed in location; some decreasing as effluent quality increases
Perchlorate	In alluvial and intermediate groundwater of Mortandad Canyon; found in regional aquifer in Mortandad and Pueblo canyons	Yes, in Pueblo Canyon	No established regulatory standard; values exceed EPA provisional risk level in alluvial groundwater and deeper groundwater	Decreasing in Mortandad Canyon alluvial groundwater as effluent quality improves; insufficient data for other groundwater
Nitrate	In alluvial and intermediate groundwater and regional aquifer in Pueblo and Mortandad canyons; above MCL in Mortandad Canyon intermediate groundwater	Yes, in Pueblo Canyon	Potential effect on drinking water; likely non-LANL source in Pueblo Canyon	Alluvial groundwater levels in Mortandad Canyon decreasing as effluent quality improves
High explosives	In alluvial, intermediate, and possibly regional groundwater in the southwestern part of LANL	No	Presence in regional aquifer uncertain	Insufficient data

Figure ES-2



Groundwater Monitoring (See Chapter 5.)

Table ES-5 shows a summary of LANL impacts on groundwater.

Groundwater at the Laboratory occurs as a regional aquifer at depths ranging from 600 to 1,200 ft and as perched groundwater of limited thickness and horizontal extent, either in canyon alluvium or at intermediate depths of a few hundred feet. In some canyons, 6 decades of liquid effluent disposal by LANL have degraded groundwater quality in the alluvium. Because flow through the underlying approximately 900-ft-thick zone of unsaturated rock is slow, the impact of effluent disposal is seen to a lesser degree in intermediate-depth perched groundwater and is only seen in some wells within the regional aquifer. All water produced by the Los Alamos County water supply system comes from the regional aquifer and meets federal and state drinking water standards. No drinking water is supplied from the alluvial and intermediate aquifers.

In recent years, elevated alluvial groundwater concentrations of strontium-90, plutonium, americium, tritium, nitrate, perchlorate, high-explosives (HE), barium, and molybdenum have approached or exceeded drinking water standards or risk-based drinking water levels in a few locations and over a limited area on site. Beginning in 2001, no groundwater has had tritium activities that exceeded the EPA drinking water Maximum Contaminant Level (MCL) of 20,000 pCi/L. Intermediate groundwater concentrations of HE, chlorinated solvents, tritium, perchlorate, and nitrate exceed or approach drinking water standards or risk-based drinking water levels in a few locations on-site. The regional aquifer shows traces of tritium and nitrate that are below drinking water risk levels. Perchlorate exceeds the EPA Region 6 risk level of 3.7 ppb (which corresponds to a hazard index of one) in a well in Mortandad Canyon, and in a nearby newly drilled borehole, nitrate is just below the New Mexico groundwater standard of 10 mg/L (nitrate as nitrogen). A Los Alamos County water supply well in Pueblo Canyon shows tritium at 1/500th of the EPA MCL, nitrate at about three times background or 1/10th of the MCL, and perchlorate at a concentration just below the EPA Region 6 risk level of 3.7 ppb.

One regional aquifer well (R-25) may show HE and chlorinated solvents near drinking water risk levels, but the results appear to be caused by well construction problems rather than indicating regional aquifer contamination. The HE and solvents at R-25 have not reached the regional aquifer and are probably restricted to the perched zone that lies at the 750-ft depth.

In order to improve the perchlorate detection limit, LANL and the NMED DOE Oversight Bureau began investigating use of the liquid chromatography/mass spectrometry/mass spectrometry (LC/MS/MS) method for perchlorate analysis to replace the currently used ion chromatography (IC) method in 2001. In late 2003, LANL began using both methods for all perchlorate measurements in water. LANL and the NMED DOE Oversight Bureau conducted a performance study of the LC/MS/MS method during 2003. This study found perchlorate in every groundwater sample analyzed from across northern New Mexico, at levels ranging from 0.12 to 0.66 ppb with a mean of 0.27 ppb. This result suggests that perchlorate may be widespread in groundwater at concentrations below 1 ppb.

LANL has shut off or significantly improved the water quality of most liquid effluent discharges (High-Explosive Wastewater Treatment Facility [HEWTF] and Radioactive Liquid Waste Treatment Facility [RLWTF]); and, with some exceptions (strontium-90), water quality in shallow groundwater has improved rapidly as a result of these Laboratory actions. In one example, the RLWTF has sharply reduced tritium activity in its discharge since 2000 to below 20,000 picocuries per liter (pCi/L), with a corresponding decrease in tritium in the alluvial groundwater since then. Also, perchlorate concentrations in the RLWTF effluent have been reduced to below detection limits with a corresponding decrease of concentration in downstream alluvial groundwater (Figure ES-2).

Table ES-6. Where Can We See LANL Impacts on Surface Water and Sediments?

Chemical	*On-Site*	*Off-Site*	*Significance*	*Trends*
Radionuclides	Higher than background in sediments because of LANL contributions in Pueblo, Los Alamos, and Mortandad canyons	Yes, in Los Alamos/ Pueblo canyons; slightly to moderately elevated in the Rio Grande and Cochiti Reservoir	Sediments below health concern except along a short distance in Mortandad Canyon but exposure potential is limited	Increased transport in Pueblo Canyon in response to postfire flooding and increased urbanization
	Higher than background in runoff in Pueblo, Los Alamos, and Mortandad canyons because of LANL contribution	Yes, in Los Alamos/ Pueblo canyons	Minimal exposure potential because events are sporadic	Flows in Pueblo Canyon occurring more often after fire; flows in LANL canyons to near prefire levels
Polychlorinated biphenyls (PCBs)	Detected in sediment in nearly every canyon	Yes, particularly in the Los Alamos/ Pueblo canyons	Minimal exposure potential; data suggests they may accumulate in Rio Grande fish; findings include non-Laboratory and Laboratory sources	None
	Detected in Sandia Canyon runoff and base flow	No		None
High explosive residues and barium	Detections above screening values in Caňon de Valle base flow	No	Minimal potential for exposure	None
Polycyclic aromatic hydrocarbons (PAHs)	Detections near or above applicable risk-based screening levels in Sandia and Mortandad canyons	Yes, in Los Alamos/ Pueblo canyons	Origins uncertain; probably multiple sources	None

Watershed Monitoring (See Chapter 6.)

Table ES-6 shows the locations of LANL-impacted surface water and sediments.

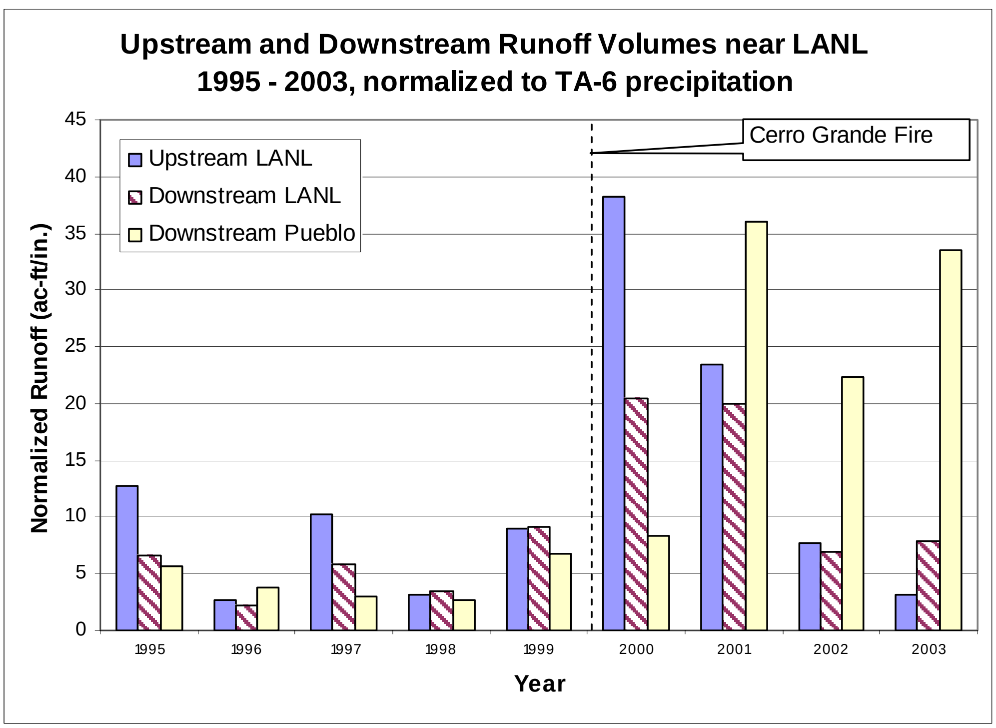
Watersheds that drain the Laboratory are dry for most of the year. No perennial surface water extends completely across the Laboratory in any canyon. Storm runoff occasionally extends across the Laboratory but is short-lived. Wildlife drink from the stream channels when water is present.

LANL activities have caused contamination of sediments in several canyons, mainly because of industrial effluent discharges. These discharges and contaminated sediments also affect the quality of storm runoff, which carries much of this sediment for short periods of intense flow. In some cases, sediment contamination lingers from Laboratory operations conducted more than 50 years ago.

Sediment radioactivity levels are above fallout background but substantially lower than screening action levels (SALs) in Los Alamos and Pueblo canyons. Cesium-137 in Mortandad Canyon sediments is at elevated levels in an approximately 1.5-mile-long reach on-site and some samples exceed industrial site soil screening levels. Plutonium-239,240 in sediments extends off-site down Los Alamos Canyon into the Rio Grande, but levels remain well below the screening levels for unrestricted use of the land. Polychlorinated biphenyls (PCBs) are present in sediments in most watercourses that drain the Laboratory and are at concentrations below EPA industrial soil screening levels in Sandia Canyon sediments, where the highest levels occur. Channel sediments in Pueblo, Los Alamos, Sandia, and Mortandad canyons contain polycyclic aromatic hydrocarbons (PAHs) of uncertain origin with maximum concentrations near or above applicable EPA soil screening levels.

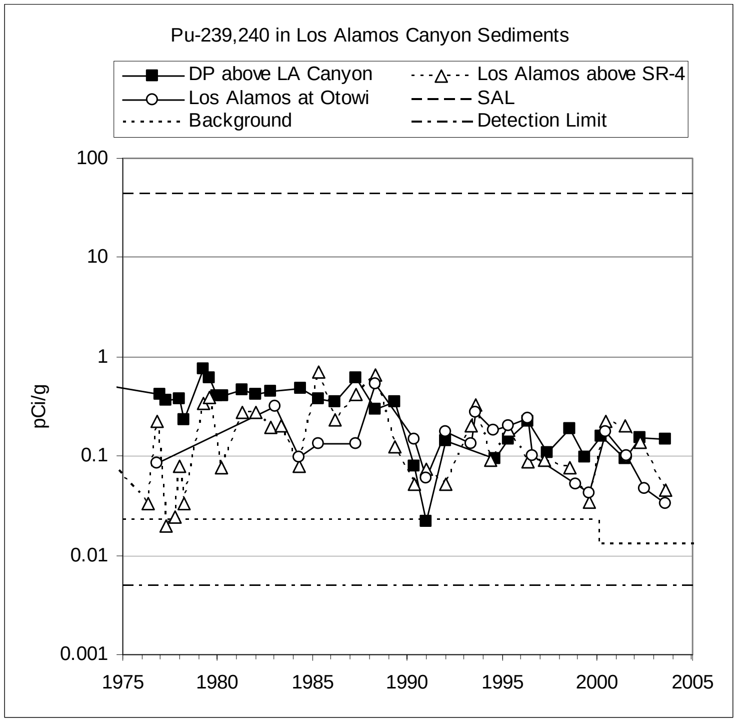
Runoff volumes in watersheds crossing current LANL boundaries have recovered to near pre-Cerro Grande fire levels (Figure ES-3). However, storm runoff in watersheds north of LANL, including Pueblo Canyon, remains high and continues the accelerated downstream movement of LANL-contaminated sediments from Pueblo Canyon into lower Los Alamos Canyon and the Rio Grande.

Figure ES-3



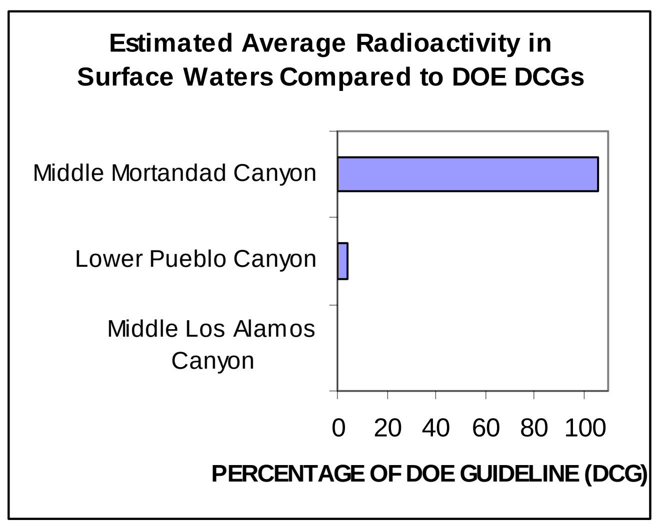
The overall pattern of radioactivity in channel sediments, such as along lower Los Alamos Canyon, has not greatly changed (Figure ES-4). Radioactivity in bottom sediments in Cochiti Reservoir has increased slightly to moderately but remains well below health-based screening levels.

Figure ES-4



Radioactivity in surface water below current radioactive effluent discharges in Mortandad Canyon was near the 100-mrem DOE Derived Concentration Guideline (DCG) for public exposure, but the water is not used as a drinking source and flows do not extend off-site (Figure ES-5). Samples of base flow (persistent surface waters) collected near the Laboratory or from the Rio Grande in 2003 met the New Mexico stream standards for livestock watering or wildlife habitat except for a PCB result from Sandia Canyon, which was greater than the wildlife habitat standard. A small number of the short-lived storm runoff events contained concentrations of some metals, gross alpha, and PCBs above the state standards or above background levels. Several Los Alamos area watersheds were recently added to the State of New Mexico's water quality impaired list for gross alpha activity and total selenium concentrations. Our review indicates that these high values appear to be related to natural causes and concentrations significantly declined in 2003.

Figure ES-5



Soil Monitoring (See Chapter 7.)

Table ES-7 shows Laboratory impacts on mesa-top soils.

Soil acts as an integrating medium that can account for contaminants released to the environment. Therefore, we collect soil surface samples within (on-site) and around the perimeter of the Laboratory (institutional program) and within and around the perimeter of the Laboratory's principal (1) low-level waste disposal area (Area G) and (2) explosive test facility (Dual Axis Radiographic Hydrodynamic Test [DARHT]) (facility program)—these programs are conducted to determine the impacts of Laboratory operations on human health and the environment. We analyze samples from these areas for radionuclides and heavy metals and then compare them with samples collected from regional (background) areas located a great distance away from the Laboratory. Concentrations, trends, and doses were assessed. Findings included the following.

- Most radionuclide concentrations (activity) in soils collected from on-site (12 sites) and perimeter (10 sites) stations around LANL were nondetectable, and of the radionuclides that were detected, most were still within regional statistical reference levels (RSRLs). RSRLs represent natural and fallout sources.
- The few radionuclides in soils from on-site and perimeter stations that were detected above RSRLs included mostly plutonium-239,240, and were probably a result of fallout because of higher precipitation events.
- Two soil samples, one collected from an on-site location (TA-21 [DP-Site]) and one from a perimeter site (west airport) contained concentrations of plutonium-239,240 above the RSRL and were associated with Laboratory activities (Figure ES-6). All concentrations, however, were far below the SAL. The SAL, based on a conservative (residential) 15-mrem/yr protective dose limit, identifies contaminants of concern.
- Most all sites, with the exception of one perimeter site (west airport), from either perimeter or on-site areas had barium, beryllium, mercury, and lead concentrations below RSRLs and do not appear to be increasing over time. The only one metal (lead) that was above the RSRL was far below the EPA screening level.
- Mercury concentrations in all soils, including regional soils, appear to be decreasing over time.

AREA G

- Most soil samples collected at Area G contained detectable concentrations of tritium (87%); plutonium-239,240 (87%); plutonium-238 (60%); and americium-241 (53%) above RSRLs. All concentrations are below LANL SALs.
- The highest levels of tritium in soils were detected in the south portion of Area G near the tritium shafts and appear to be increasing over time, whereas the highest concentrations of the plutonium isotopes were detected in the northern and northeastern portions

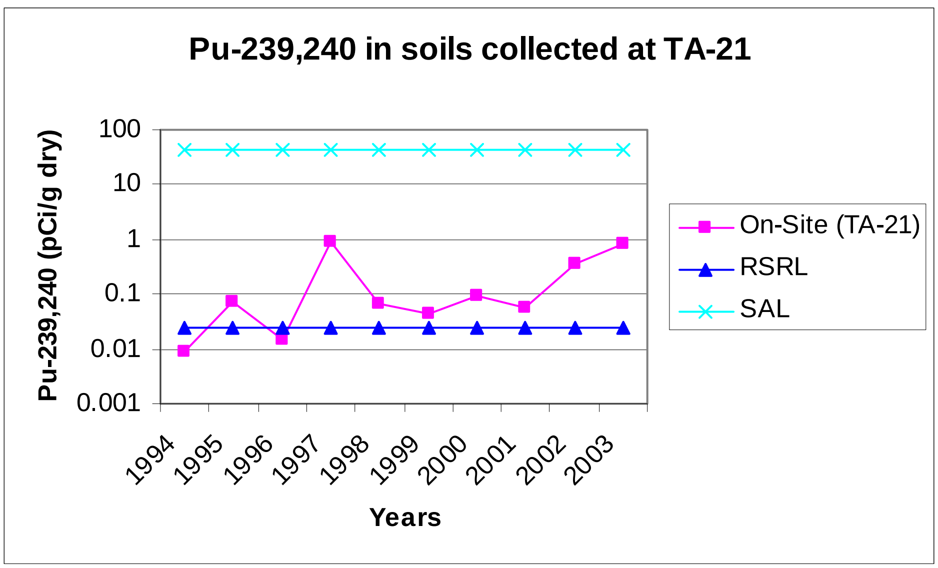
DARHT

- Most radionuclides, with the exception of uranium; cesium-137; and plutonium-239,240, and trace elements, with the exception of antimony, selenium, and copper, in some soil and sediment samples were below baseline statistical reference levels (BSRL). BSRLs were established for a four-year-long preoperational period before DARHT operations. All elements were below LANL and EPA SALs and are of no concern.
- No distinctive trends were evident in any of the radionuclides or metals over time.

Table ES-7. Where Can We See LANL Impacts on Mesa-Top Soils?

Chemical	*On-Site*	*Off-Site*	*Significance*	*Trends*
Tritium	Yes, at some sites, particularly at Area G, TA-54, because of LANL contributions	Yes, in a few perimeter areas north of LANL	Far below screening level; no health risk	Increasing at Area G, TA-54, particularly in the south/southwestern section, near the tritium shafts
Other radionuclides	Yes, mostly plutonium-239,240 at Area G and TA-21	Yes, plutonium-239,240 in a few perimeter areas north of LANL	Far below screening levels; no health risk	Plutonium-239,240 is highly variable from sample to sample
Metals	Few detections: lead, mercury, barium, beryllium	Mostly no, but lead was detected in one soil sample	Far below screening levels; no health risk	Decreasing, particularly mercury

Figure ES-6



Foodstuffs and Nonfoodstuffs Biota Monitoring (See Chapter 8.)

Table ES-8 presents a summary of Laboratory impacts on foodstuffs.

A wide variety of wild and domestic edible plant, fruit, and fish and animal products are harvested in the area surrounding the Laboratory. Therefore, we collected foodstuff and nonfoodstuff biota within and near LANL property to help determine the impacts of Laboratory operations on human health, through the food chain, and to the environment. Also, we collected nonfoodstuff biota at Area G, the Laboratory's principal low-level waste disposal area and the Laboratory's principal explosive test facility (DARHT). Concentrations, trends and doses were assessed.

Produce was analyzed for radionuclides and perchlorates; fish were analyzed for radionuclides, mercury, and perchlorates; small (rabbits) and big (deer and elk) game animals were analyzed for radionuclides; and, vegetation was analyzed for radionuclides. Findings included the following.

- The concentrations of most radionuclides in fruits, vegetables, and grains collected from regional areas were indistinguishable from worldwide fallout and/or natural sources.
- Produce and water samples collected from Los Alamos and White Rock/Pajarito Acres town sites irrigated with local groundwater sources and samples collected from Cochiti and Santa Clara pueblo areas irrigated with Rio Grande water contained no perchlorate concentrations above the minimum reporting level (MRL) or the minimum detection level (MDL).
- Most radionuclides in bottom-feeding fish collected from Cochiti Reservoir, downstream of LANL, were nondetectable or within RSRLs. The radionuclides that were detected above the RSRLs were isotopes of naturally occurring uranium.
- All individual mercury concentrations in bottom-feeding fish (fillets) collected from Cochiti Reservoir were similar to concentrations upstream of LANL (Abiquiu reservoir) and far below the US Food and Drug Administration's ingestion limit of 1 µg mercury/g wet weight. Long-term data show that mercury concentrations in fish from both reservoirs are decreasing over time.
- Results of the analysis of perchlorate in predator and bottom-feeding fish from Cochiti and Heron reservoirs show no concentrations in any of the fish (fillet) samples above the MRL.
- Rabbits collected from San Ildefonso lands contained five times higher concentrations of strontium-90 in muscle and bone tissues as compared with RSRLs. All other radionuclides were within RSRLs. Although strontium-90 has been reported in above-background concentrations in mice within Mortandad canyon approximately 0.5 miles north of where the rabbit samples were collected, more samples are required from both San Ildefonso and regional background areas before any conclusions can be made as to whether or not these levels are due to Laboratory operations.
- Most radionuclide concentrations in muscle and bone tissues of deer collected from the perimeter areas—Los Alamos and San Ildefonso—were nondetectable or below RSRLs. Only tritium was detected above the RSRL in muscle and bone tissues of deer collected from Los Alamos and San Ildefonso areas, but the differences were small.

Table ES-8. Where Can We See LANL Impacts on Foodstuffs?

Media	*Chemical*	*On-Site*	*Off-Site*	*Significance*	*Trends*
Produce	**Tritium**	Not collected in 2003, but historically slightly higher than background	Yes, in a few perimeter areas north and southeast of LANL	Dose, <0.1 mrem/yr; no health risk	None
Produce	**Other radionuclides**	No	No	Dose, <0.1 mrem/yr; no health risk	None
Produce	**Perchlorate**	N/A	No	No health risk	None
Produce	**Metals**	No	No	No health risk	None
Fish	**Radionuclides**	N/A	No	Dose, <0.1 mrem/yr; no health risk <1 rad/day; no risk to aquatic organisms	None
Fish	**Perchlorate**	N/A	No	No health risk	None
Fish	**Mercury**	N/A	No	Dose, <1 µg/g wwt; however, there are various fish ingestion advisories by NMED	Decreasing
Vegetation	**Tritium**	Higher than back-ground, especially at Area G	No	Dose <1 rad/day; no risk to terrestrial plants	None
Vegetation	**Other radionuclides**	Plutonium-239,240 higher than back-ground at Area G	No	Dose, <1 rad/day; no risk to terrestrial plants	None
Rabbits	**Radionuclides**	N/A	Strontium-90 in muscle and bone from San Ildefonso	Dose, <0.1 mrem/yr; no health risk <0.1 rad/day; no risk to terrestrial wildlife	N/A
Deer/Elk	**Radionuclides**	Not collected in 2003, but historically slightly higher than background	Mostly no, but tritium in some tissues	Dose , <0.1 mrem/yr; no health risk <0.1 rad/day; no risk to terrestrial wildlife	None

- All radionuclide concentrations in muscle and bone of elk collected from LANL and perimeter (San Ildefonso) lands were nondetectable or below RSRLs.
- Nonfoodstuff biota test results from on-site locations for understory vegetation show that most radionuclide concentrations in samples from on-site and perimeter stations were nondetectable or within RSRLs. The very few detections that were above RSRLs included plutonium-239,240 in understory vegetation at TA-21, which correlates well with the soils data. These results remain well below levels that would exceed limits for the protection of nonhuman biota.

AREA G

- Most radionuclides, with the exception of tritium and plutonium-239,240, in vegetation and small mammals were within RSRLs.
- Tritium and plutonium-239,240 were both significantly higher in vegetation and small mammals from both on-site and off-site areas surrounding Area G as compared with RSRLs. The highest tritium concentrations were detected in the southwestern portion of Area G, and some foliar contamination from plutonium in/on a few plant samples was detected in the northern sections of Area G.
- One mouse sample from on-site exhibited unusually high levels of plutonium-238; plutonium-239,240; cesium-137; americium-241; and strontium-90. This sample was from animals collected from the southeastern portion of the site. There is no apparent reason why this particular sample exhibited such high values and does not correlate well with past data.
- A vegetation transect study using tree branch tips collected at various distances (approximately 10, 50, 100, 150, and 200 m) from the perimeter of Area G in seven directions showed that tritium concentrations in trees collected nearest the perimeter boundary (10 to 16 m) around Area G were higher than the RSRL. From there, most transects showed decreasing concentrations with distance and at around 90 m were similar to RSRLs.

DARHT

- Most radionuclides, with the exception of uranium, and trace elements, with the exception of copper and selenium, in vegetation were below BSRL values.

1. Introduction

A. Laboratory Overview

1. Introduction to Los Alamos National Laboratory

In March 1943, a small group of scientists came to Los Alamos for Project Y of the Manhattan Project. Their goal was to develop the world's first nuclear weapon. Although planners originally expected that the task would require only 100 scientists, by 1945, when the first nuclear bomb was tested at Trinity Site in southern New Mexico, more than 3,000 civilian and military personnel were working at Los Alamos Laboratory. In 1947, Los Alamos Laboratory became Los Alamos Scientific Laboratory, which in turn became Los Alamos National Laboratory (LANL or the Laboratory) in 1981. The Laboratory is managed by the Regents of the University of California (UC) under a contract that is administered by the National Nuclear Security Administration (NNSA) of the Department of Energy (DOE) through the Los Alamos Site Office (LASO) and the Albuquerque Operations Office.

The Laboratory's original mission to design, develop, and test nuclear weapons has broadened and evolved as technologies, US priorities, and the world community have changed. Los Alamos National Laboratory enhances global security by

- ensuring the safety and reliability of the US nuclear deterrent;
- reducing the global threat of weapons of mass destruction; and
- solving national problems in energy, infrastructure, and health security (LANL 2001a).

In the "Strategic Plan (2001–2006)," Los Alamos National Laboratory personnel explain LANL's vision and role as follows: "We serve the nation by applying the best science and technology to make the world a better and safer place . . . . Inseparable from its commitment to excellence in science and technology is LANL's commitment to completing all endeavors in a safe, secure, and cost-effective manner" (LANL 2001b).

2. Geographic Setting

The Laboratory and the associated residential and commercial areas of Los Alamos and White Rock are located in Los Alamos County, in north-central New Mexico, approximately 60 miles north-northeast of Albuquerque and 25 miles northwest of Santa Fe (Figure 1-1). The 40-square-mile Laboratory is situated on the Pajarito Plateau, which consists of a series of finger-like mesas separated by deep east-to-west-oriented canyons cut by streams. Mesa tops range in elevation from approximately 7,800 ft on the flanks of the Jemez Mountains to about 6,200 ft above the Rio Grande Canyon. Most Laboratory and community developments are confined to the mesa tops. The surrounding land is largely undeveloped; and large tracts of land north, west, and south of the Laboratory site are held by the Santa Fe National Forest, the US Bureau of Land Management, the Bandelier National Monument, the US General Services Administration, and the Los Alamos County. San Ildefonso Pueblo borders the Laboratory to the east.

The Laboratory is divided into technical areas (TAs) that are used for building sites, experimental areas, support facilities, roads, and utility rights-of-way. (See Appendix C and Figure 1-2.) However, these uses account for only a small part of the total land area; much land provides buffer areas for security and safety and is held in reserve for future use.

3. Geology and Hydrology

The Laboratory lies at the western boundary of the Rio Grande Rift, a major North American tectonic feature. Three major local faults constitute the modern rift boundary, and each is potentially seismogenic. Recent studies indicate that the seismic surface rupture hazard associated with these faults is localized (Gardner et al. 1999). Most of the finger-like mesas in the Los Alamos area (Figure 1-3) are formed from Bandelier Tuff, which includes ash fall, ash fall pumice, and rhyolite tuff. Deposited by major eruptions in the Jemez Mountains' volcanic center 1.2–1.6 million years ago, the tuff is more than 1,000 ft thick in the western part of the plateau and thins to about 260 ft eastward above the Rio Grande.

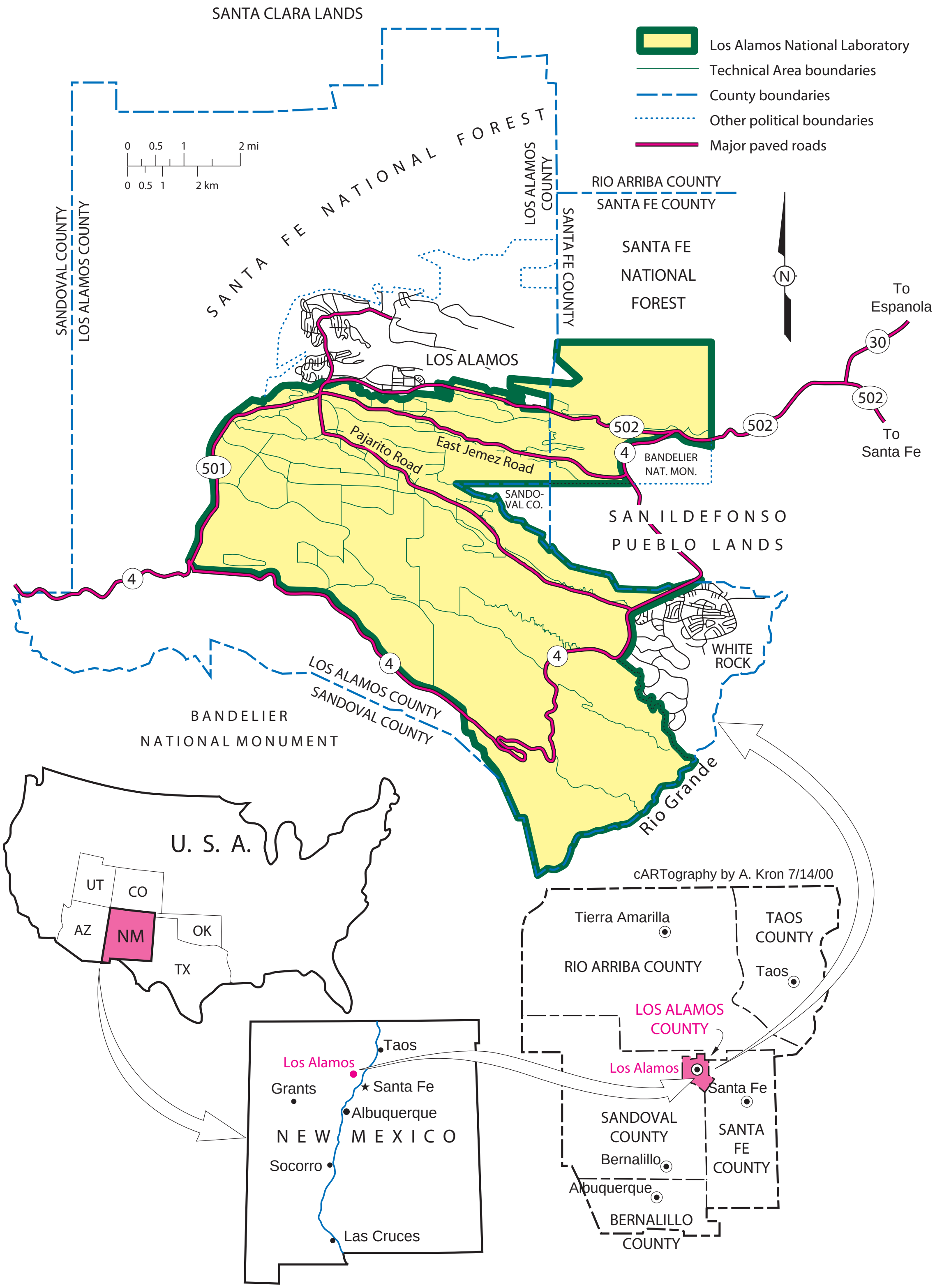


Figure 1-1. Regional location of Los Alamos National Laboratory.

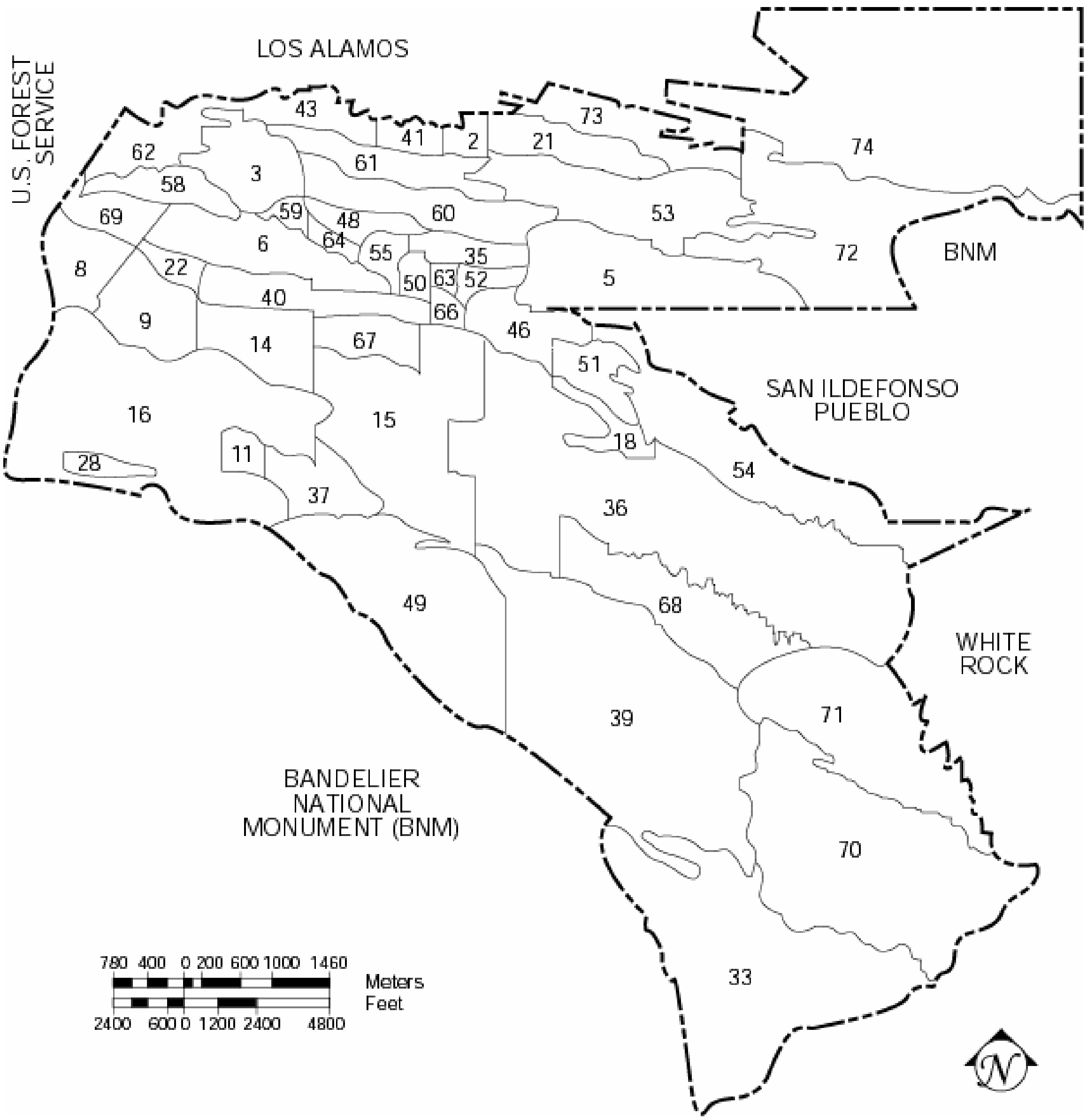


Figure 1-2. Technical Areas of Los Alamos National Laboratory in relation to surrounding landholdings.

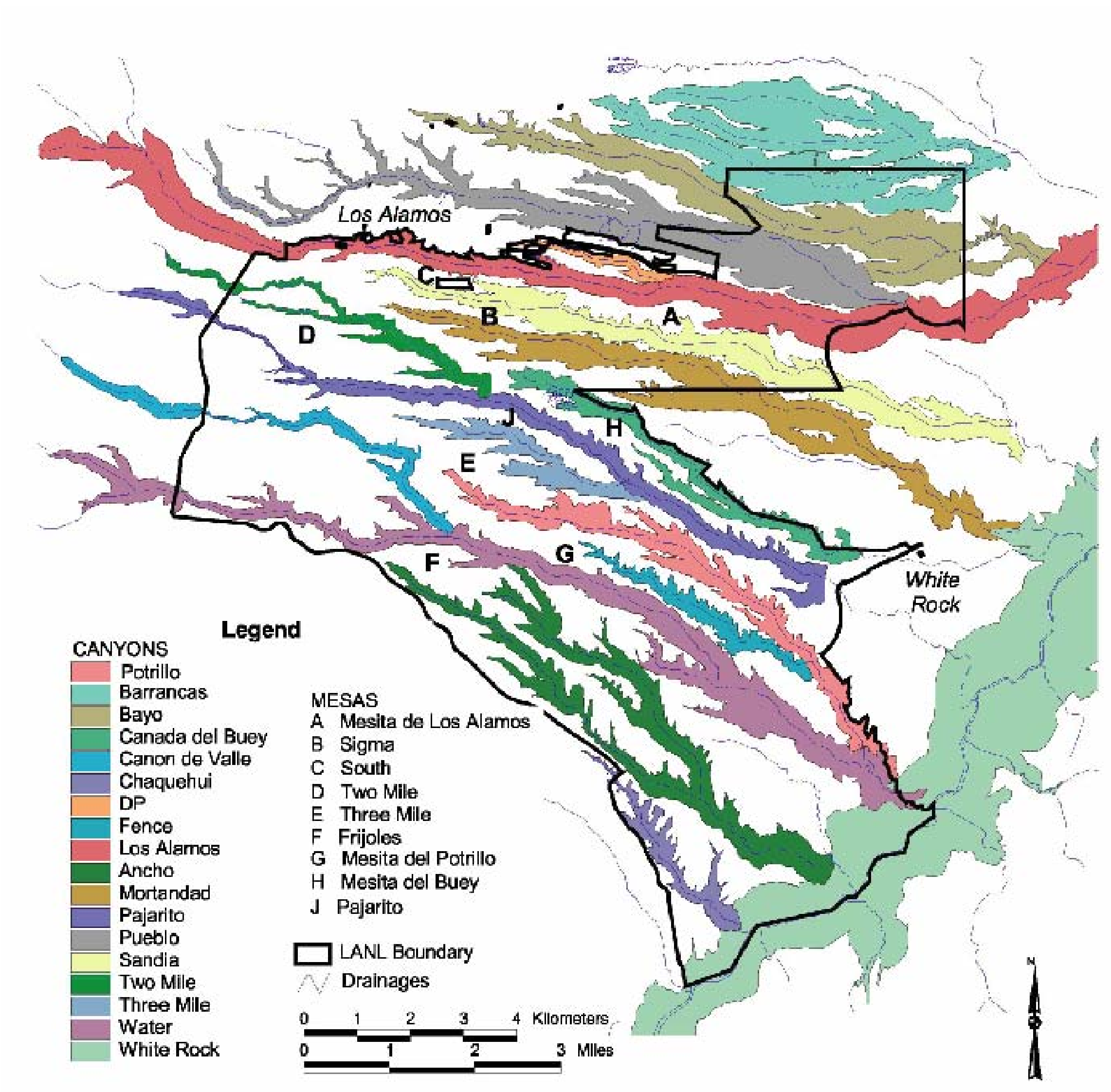


Figure 1-3. Major canyons and mesas.

On the western part of the Pajarito Plateau, the Bandelier Tuff overlaps onto the Tschicoma Formation, which consists of older volcanics that form the Jemez Mountains. The tuff is underlain by the conglomerate of the Puye Formation in the central plateau and near the Rio Grande. The Cerros del Rio Basalts interfinger with the conglomerate along the river. These formations overlie the sediments of the Santa Fe Group, which extend across the Rio Grande Valley and are more than 3,300 ft thick.

Surface water in the Los Alamos area occurs primarily as short-lived or intermittent reaches of streams. Perennial springs on the flanks of the Jemez Mountains supply base flow into the upper reaches of some canyons, but the volume is insufficient to maintain surface flows across the Laboratory site before the water is depleted by evaporation, transpiration, and infiltration.

Groundwater in the Los Alamos area occurs in three modes: (1) water in shallow alluvium in canyons, (2) perched water (a body of groundwater above a less permeable layer that is separated from the underlying main body of groundwater by an unsaturated zone), and (3) the regional aquifer of the Los Alamos area, which is the only aquifer in the area capable of serving as a municipal water supply. Water in the regional aquifer is in artesian conditions under the eastern part of the Pajarito Plateau near the Rio Grande (Purtymun and Johansen 1974). The source of most recharge to the aquifer appears to be infiltration of precipitation that falls on the Jemez Mountains. The regional aquifer discharges into the Rio Grande through springs in White Rock Canyon. The 11.5-mile reach of the river in White Rock Canyon, between Otowi Bridge and the mouth of Rito de los Frijoles, receives an estimated 4,300–5,500 acre-feet of water annually from the aquifer.

4. Biology and Cultural Resources

The Pajarito Plateau is a biologically diverse and archaeologically rich area. This diversity is illustrated by the presence of more than 900 species of plants; 57 species of mammals; 200 species of birds, including 112 species known to breed in Los Alamos County; 28 species of reptiles; 9 species of amphibians; over 1,200 species of arthropods; and 12 species of fish (primarily found in the Rio Grande, Cochiti Reservoir, and the Rito de los Frijoles). No fish species have been found within LANL boundaries. Roughly 20 of these plant and animal species are designated as threatened species, endangered species, or species of concern at the federal and/or state level.

Approximately 80% of DOE land in Los Alamos County has been surveyed for prehistoric and historic cultural resources, and more than 1800 sites have been recorded. More than 85% of the ruins date from the 14th and 15th centuries. Most of the sites are found in the piñon-juniper vegetation zone, with 80% lying between 5,800 and 7,100 ft. Almost three-quarters of all ruins are found on mesa tops. Buildings and structures from the Manhattan Project and the early Cold War period (1943–1963) are being evaluated for eligibility for listing in the National Register of Historic Places.

B. Management of Environment, Safety, and Health

1. Environmental Management System Description

LANL is actively developing and implementing an Environmental Management System (EMS) pursuant to DOE Order 450.1 (Environmental Protection Program) using ISO 14001 standards as a model. It is LANL's intent to be able to self-declare an EMS by December 2004, and to be prepared to submit for independent third party ISO 14001 certification by December 2005.

Key steps in EMS development have already been taken. Gap analyses comparing DOE O 450.1 and ISO 14001 standard requirements with existing Integrated Safety Management (ISM) systems were conducted in FY03. An EMS Core Team and EMS Element Teams (Policy, Planning, Implementation Checking and Corrective Action, and Management Review) were chartered and produced an EMS Program Plan in January 2004.The current LANL ISM Description Document has been revised to reflect EMS requirements. In March 2004, LANL Director Pete Nanos issued an ISO-compliant LANL Environmental Policy that has been incorporated into LANL Governing Policies. Element Teams have completed work describing environmental aspects and impacts and are completing the prioritization process. A communications plan detailing internal and external communication pathways has been drafted. A Memorandum of Agreement has been approved between LANL and major subcontractors to assure site-wide coordination of EMS development. Regular progress briefings are being provided to LANL groups, divisions, and management units as well as to the NNSA Site Office.

A critical step in integrating the EMS with ISM is the direct translation of the developed environmental aspects and impacts into the Automated Job Hazard Analysis tool being inaugurated under Phase II of LANL's Integrated Work Management (IWM) program. More than 20 environment subject matter experts were engaged in this integration process. Future work approval will require evaluation of environmental hazards, controls, and pollution prevention opportunities, meeting many DOE O 450.1 and ISO 14001 EMS requirements.

2. Pollution Prevention Program Description

The Pollution Prevention (P2) program implements waste minimization, pollution prevention, sustainable design, and conservation projects to increase operational efficiency, reduce life-cycle costs, and reduce risk. Reducing waste directly contributes to the efficient performance of Los Alamos' national security, energy, and science missions. Specific P2 activities include

- data collection and reporting on DOE P2 goals;
- waste volume forecasting to identify P2 opportunities;
- conducting pollution prevention opportunity assessments for customer divisions;
- funding specific waste reduction projects through the Generator Set-Aside Fund program;
- managing affirmative procurement efforts;
- conducting an annual LANL P2 awards program to recognize achievement;
- supporting sustainable design for the construction of new buildings; and
- communicating P2 issues to the laboratory community.

The P2 program has recognized projects that have saved the Laboratory over $7 M during the past 2 years.

3. Risk Reduction and Environmental Stewardship Division

The Risk Reduction and Environmental Stewardship (RRES) Division is a Laboratory support organization that primarily provides a broad range of technical expertise and assistance in areas such as environmental protection, pollution prevention, National Environmental Policy Act (NEPA) requirements, wildfire protection, and natural and cultural resources management. RRES Division is in charge of performing environmental monitoring, surveillance, and compliance activities to help ensure that Laboratory operations do not adversely affect human health and safety or the environment.

The Laboratory conforms to applicable environmental regulatory and reporting requirements of DOE Orders 5400.1 (DOE 1988), 5400.5 (DOE 1990), and 231.1 (DOE 1995). RRES Division has the responsibility and the authority for serving as the central point of institutional contact, coordination, and support for interfaces with regulators, stakeholders, and the public, including the DOE/NNSA, the US Defense Nuclear Facilities Safety Board, the New Mexico Environment Department, and the Environmental Protection Agency.

RRES Division provides line managers with assistance in preparing and completing environmental documentation. Such documentation includes reports required by (1) NEPA of 1969 and (2) the federal Resource Conservation and Recovery Act (RCRA) and (3) its state counterpart, the New Mexico Hazardous Waste Act, as documented in Chapter 2 of this report. With assistance from Laboratory legal counsel, RRES Division helps to define and recommend Laboratory policies for applicable federal and state environmental regulations and laws and DOE orders and directives. RRES Division is responsible for communicating environmental policies to Laboratory employees and makes appropriate environmental training programs available.

The Environmental Surveillance Program resides in four RRES Division groups—Meteorology and Air Quality (RRES-MAQ), Water Quality and Hydrology (RRES-WQH), Solid Waste Regulatory Compliance (RRES-SWRC), and Ecology (RRES-ECO). These groups initiate and promote Laboratory programs for environmental assessment and are responsible for environmental surveillance and regulatory compliance under the auspices of the division's Environmental Protection Program (RRES-EP).

RRES Division uses approximately 600 sampling locations for routine environmental monitoring. The maps in this report present the general location of monitoring stations. For 2003, Laboratory personnel performed more than 250,000 routine analyses for chemical and radiochemical constituents on more than 12,000 routine environmental samples. Laboratory personnel also collected many additional samples in continuing efforts to monitor the effects of the Cerro Grande fire that occurred in 2000, burning more than 7,500 acres of Laboratory property. Samples of air particles and gases, water, soils, sediments, foodstuffs, and associated biota are routinely collected at monitoring stations and then analyzed. These analyses help identify impacts of LANL operations on the environment. RRES personnel collect and analyze additional samples to obtain information about particular events, such as major surface-water runoff events, nonroutine radiation releases, or special studies.

C. References

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